

A preliminary review of the Pomatiasid land snails of Central America (Mollusca, Prosobranchia).

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With plates 10-12 and 2 maps.

Pomatiasid land snails are found in Central America from middle Vera Cruz, Mexico, to the Colombian border. The wide distributional gaps (see maps 1 and 2) probably reflect both inadequate collecting and the snails' apparent restriction to limestone outcrop areas. Available data on the range, synonymy, variability and identifying characters are summarized below. Two new species, *Chondropoma callipeplum* and *Tudora (Tudorata) thomasi*, are described and most of the remaining species are figured. A few species are known only from their original descriptions and no examples were seen during this study.

Considerable museum material has accumulated since the summaries of FISCHER & CROSSE (1880-1902: 169-218) and MARTENS (1890-1902: 12-20). A little data on sexual variation presented by H. B. BAKER (1928) also materially alters the earlier concepts of speciation and suggests numerous possibilities for field studies. Study of the museum specimens indicated the presence of a characteristic dimorphic sculptural variation, in which the same species shows crowded and widely spaced sculptural types. Five, possibly six, such sets were identified, and are considered to be intra-specific variations. In *Chonanopoma sumichrasti* and *Chondropoma rubicundum* these morphs may have a geographic basis and represent subspecies. In the other cases the variation seems to be individual. The nature of these variants is unknown, but the possibility of phenotypic response to changing environmental conditions must be considered.

The studied material did not lend itself to statistical analysis of variation (see below) and was totally inadequate to settle many problems of systematic affinities and distribution. Essentially, this study attempts to provide a synopsis of previous work, a series of notes on identification features and variability, and an outline of possible facets for field investigation. Data on these species was widely scattered and no prospectus of the biological and systematic problems relating to this group existed.

Material from several museum collections was examined during this study. For convenient reference, the names have been abbreviated in the text as follows:

ANSP Academy of Natural Sciences, Philadelphia
CNHM Chicago Natural History Museum
MCZ Museum of Comparative Zoology, Harvard

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Introduction.

The land snail family Pomatiasidae (= Annulariidae of BARTSCH et al.) has two centers of distribution: the West Indies and the islands off the east coast of Africa. The African taxa are most abundant on Madagascar, the smaller Mascarene Islands, and Socotra, with some genera present on the East and South African mainland and a few species ranging around the Mediterranean Sea and into Middle Europe. The American taxa are quite abundant on the West Indian Islands, particularly Cuba, Santo Domingo and Jamaica, with a few forms on the adjacent South American and Central American mainlands. The South American species were reviewed by SOLEM (1960), the Central American species are considered below.

BARTSCH and his associates have placed the old world and the new world species in different families, but the basis used in separation seems inadequate (see H. B. BAKER 1924: 89-91) and obscures their very close anatomical relationship. There is not yet enough evidence to be certain that even subfamilial separation is justified.

Little is known of the ecology or life history of the American pomatiasids. Available data suggest that most species are obligatory calcicoles. Dead shells are common around limestone outcrops and living specimens inhabit crevices of limestone outcrops or under limestone chips. Some species have been found in leaf mould in calcareous areas. Dispersal is undoubtedly facilitated by their often reported habit of ascending vegetation and hanging from leaves by a mucous thread (see Amer. J. Conch., 4: 11, pl. 1 fig. 15; H. B. BAKER 1923: 23-24). Such individuals can be carried about by wind or storms.

The pomatiasids are prosobranchs and the sexes are separate. The only study of new world species that utilized live collected and sexed material (H. B. BAKER 1928: 46-50) demonstrated that the females are larger than the males, although size range somewhat overlapped. The sex ratios varied from species to species and BAKER's limited data prevents any conclusions as to whether the reported ratios are constant within a species or vary between populations. Museum series consist of cleaned shells and cannot be sexed.

Since land prosobranchs are extremely sensitive to local environmental variations and vary widely under different moisture and shelter conditions (H. B. BAKER 1943: 106-107) the importance of size differences between lots in collections becomes even more difficult to evaluate. Measurement of height is complicated in many species by the habit of losing the early whorls. The animal

forms a large, often purple colored, plug in the upper spire, and the early whorls then become broken off, probably accidentally when rains or winds tumble the shell to the ground. The plug is located in approximately the same place on each individual, but the break can occur at different points above the plug. Thus, measurements of height are not strictly comparable and determination of the number of remaining whorls can be a highly subjective matter. Where possible, this has been done by treating the plug as the apex. In specimens where the tip of the plug is not visible, counts have had to be made from the edge of the broken spire.

The variable nature of the known sex ratios, the different size of the males and females, phenotypic variation, inaccurate height measurement, and the few specimens per lot in collections all combine to make statistical analysis of available material useless. Too many uncontrolled variables remain for measurements of unsexed shells to be considered reliable indicators of species or population differences. For these reasons, data on size is given only in terms of the largest and smallest individuals examined.

It is equally difficult to assess variation in sculpture, operculum, color and whorl contour. Examination of any more than five or six species of American pomatiasids leads to the conclusion that there has been a bewildering amount of minor variation. Nearly every conceivable type of ribbing, color pattern, lip variation, shell shape and opercular characters has been produced. Combinations of these different variables form no immediately apparent pattern. If West Indian, Central American and South American species are examined, the variability encountered suggests that similar minor shell variations have been independently produced in phyletic lines in different areas, and that correlation of different shell characters follow almost a random pattern. Variation within species is considerable, both in size and sculpture.

BARTSCH, et al., divided the American pomatiasids into four subfamilies, and fifty-seven genera with an additional forty-nine subgenera. All these taxa were based on single "key characters" and, while producing a neat card-filing system, probably bear only coincidental relationship to phylogeny (see SOLEM 1960: 419-420, 426 for a discussion of variation versus BARTSCH's classification). More than 600 species have been described and are recognized in the latest monographic treatments. They are distributed as follows:

Cuba	332	(TORRE & BARTSCH 1938, 1941
Haiti	133	(BARTSCH 1946)
Jamaica	67	(VENDRYES 1899)
Bahamas	45	(BARTSCH 1946)
Central America	17	(this study)
South America	7	(SOLEM 1960)
Porto Rico	7	(VAN DER SCHALIE 1948)
Other	30	(estimated fauna of Lesser Antilles, Dutch West Indies, Cayman Islands, St. Andrews, Old Providence, etc.)

Some of the "species" of BARTSCH are based on male and female shells of the same species and others can be demonstrated to be at best subspecifically separable. The above figures do serve to indicate the general abundance and relative

importance of the family in New World's areas, although they probably give at least a 25% exaggeration of the actual speciation.

With more than 110 generic and subgeneric units available for the American pomatiasids, reclassification becomes a difficult and highly involved process. H. B. BAKER has suggested (in litt. and personal communication) that radular structures will offer some criteria for generic classification, but even this will not, by itself, be satisfactory. In any survey of forms from a limited area, no general reclassification is possible. Nevertheless, some decisions on the generic positions of the species must be made.

I have chosen to adopt a very conservative course and recognize three generic groups. The new Panamanian species, *Tudora thomasi*, is clearly related to the South American and Curacao *Tudora* (*Tudorata*). Species with a multiplex peristome and calcareous plates on the operculum (completely worn away in some individuals) are placed in *Choanopoma*, although this name may not be the oldest one available when relationships to West Indian species are clarified. Species with a simple corneus operculum are placed in *Chondropoma*. The latter two names have been traditionally associated with at least some mainland forms, and, pending reclassification of the entire West Indian complex, perhaps had best be retained.

Review of species.

Genus ***Choanopoma*** PFEIFFER, 1847

(= *Annularia* of authors, not SCHUMACHER, 1817).

Type species *Turbo lincina* LINNÉ, 1758.

Remarks The species included here have a moderately to widely expanded multiplex peristome and normally the operculum has more or less intricately sculptured calcareous plates. In some specimens, however, the plates become worn off and the operculum appears to be corneus as in *Chondropoma*. There is considerable variation in the angle, extent and sculpture of the calcareous plates and there is some variation in the position of the opercular nucleus.

Possibly the Central American *Choanopoma* were derived from several West Indian stocks and represent multiple introductions to the mainland. While individual species from Central America can be compared relatively successfully with West Indian forms, there is nevertheless a general spectral range of variation in sculpture and opercular characters among the Central American shells. There is thus sufficient justification to group them as a unit. Since the subgeneric name *Choanopomops* H. B. BAKER, 1928 was based on the Yucatan *Choanopoma largillierti*, it has been adopted as a convenient reference for the Central American, as opposed to the West Indian, populations. The *Choanopoma* of South America (see SOLEM 1960: 423-428) parallel the Central American species in type of variation and have also been included in *Choanopomops*. When the classification of the West Indian species is stabilized, referral of the mainland species to sectional or subgeneric groups may become possible. Until then, no stability in names is possible and I prefer to leave them as an admittedly polyphyletic unit.

Variational trends are rather complex. The probably related *C. rigidulum* and *C. osberti* are slender shells with strongly solute body whorls. The Honduran *C. pleurophorum* is a globose shell with a less markedly solute body whorl. Its sculpture, however, is totally unlike that of the first two species, resembling instead a modification of the Roatan and Utila Island *C. andrewsi*. This species is squat in shape and, together with the similarly shaped *C. cozumelensis*, has the operculum "dished" with the calcareous plates overlapping or fusing. *C. cozumelensis*, although having the shape and operculum of the Honduran shells, has the sculpture of *C. martensianum*. This Tabascan shell, however, is slender and the sculpture of high lamellar ribs overshadows the very low spiral cords. In the Yucatan *C. gaigei* the spiral cords become nearly equal to the axial ribs on lower whorls. This species resembles the Chiapan *C. sumichrasti* in spacing of axial ribs, but the latter has no spiral sculpture. Very prominent radial and spiral sculpturing is found in *C. largillierti* (in which axial ribs coalesce to form "blobs" at the suture); *C. radiosum* (which has thin lamellar ribs that are often serrate); and in the poorly known *C. küsteri* and *C. gruneri*.

There is thus every gradation from no spiral to heavy spiral sculpture; from slender to obese shells with similar sculpture; from lamellar to rounded ribs; and from flat to "dished" or concave opercula.

Shells from the off-shore islands (Cozumel, Roatan and Utila) agree in shape and operculum, but disagree in sculpture. Shells from the mainland agree in sculpture with one of the two island forms, but disagree in shape. By selecting single characters it would be possible to "pigeon-hole" these species into groups. Variational trends, however, do not parallel each other and I am unable to see any clear dichotomy by which species groups could be recognized. Possibly study of the anatomy will provide satisfactory clues to affinities, but current information suggests that they had best remain undivided.

***Choanopoma (Choanopomops) rigidulum* (MORELET).**

Pl. 10 Fig. 1; Pl. 12 Fig. 24a.

Cyclostoma rigidulum MORELET, 1851. Test. noviss. Amer. Cent., 2: 18, no. 126 — Vera Paz, Guatemala.

Adamsiella rigidula (MORELET), — FISCHER & CROSSE, 1888, Miss. Sci. au Mexique, Moll., 2: 176-178, pl. 42 figs. 12, a-b.

Choanopoma rigidulum (MORELET), — MARTENS, 1890, Biol. Centr. Amer. Moll., pl. 1 fig. 3; HAAS & SOLEM, 1960, Nautilus, 73 (4): 130 — Río Frio Cave East, 2 miles from Augustine, Cayo District, British Honduras.

Distribution. Vera Paz, Guatemala and Cayo District, British Honduras.

Diagnostic characters. Small (7.0-9.5 mm.), relatively slender (h/d ratio 2.04-2.21) shells with high, widely spaced, lamellar axial ribs, no spiral sculpture and a markedly solute body whorl. Whorls remaining $3\frac{7}{8}$ to $4\frac{1}{8}$.

Remarks. Apparently a quite rare species of spotty distribution. Two other mainland species have solute body whorls; the Honduran *C. pleurophorum* (Figure 8) is globose and has quite different sculpture; the Guatemalan *C. osberti* has a more slender form, is larger and has the axial sculpture lower

and more crowded. *C. pleurophorum* is quite obviously distinct, but it should be noted that the differences between *osberti* and *rigidulum* are the same type that separate *Chondropoma rubicundum* and its variety *acerbulum*. In the latter case, intergrades were seen in several sets. No intergrades between *rigidulum* and *osberti* were seen, but less than twenty specimens were available and the localities were widely separated. The records for *C. osberti* are from 1,000 and 4,725 feet elevations. Possibly *osberti* is an upland form of *rigidulum*.

***Choanopoma (Choanopomops) osberti* (TRISTAM).**

Pl. 10 Fig. 2; Pl. 12 Fig. 24b.

Adamsiella osberti TRISTAM, 1861, Proc. Zool. Soc. London, 1861: 232 — vicinity of Duenas, Sacatepequez, Guatemala; FISCHER & CROSSE, 1890, Miss. Sci. au Mexique, 2: 178-179, pl. 42 figs. 13, a-b.

Choanopoma osberti (TRISTAM), — MARTENS, 1890, Biol. Centr. Amer., Moll., p. 16. *Annularia (Annularis)* (sic) *rigidula* HAAS, 1949, (not MORELET, 1851), Nautilus, 62 (4): 137 — edge of Cahabon River, Lanquin, Alta Vera Paz, Guatemala at 1,000 feet elevation.

Distribution. Sacatepequez and Alta Vera Paz, Guatemala.

Diagnostic characters. Small (9.8-12.6 mm.), slender (h/d ratio 2.28-2.88) shells with low, rounded axial ribs that are fairly closely spaced, no spiral sculpture and a markedly solute body whorl. Whorls remaining $4\frac{1}{2}$ -5.

Remarks. Duenas is at 4,725 feet and Lanquin at 1,000 feet. The known locality for *rigidula* is less than 500 feet so that the possibility exists that *osberti* and *rigidulum* are altitudinal subspecies.

***Choanopoma (Choanopomops) sumichrasti* CROSSE & FISCHER.**

Pl. 10 Fig. 3, 4; Pl. 12 Fig. 24 c, d.

Choanopoma sumichrasti CROSSE & FISCHER, 1874, J. de Conch., 22: 283 — Isthmus of Tehuantepec, Mexico, FISCHER & CROSSE, 1890, Miss. Sci. au Mexique, Moll., 2: 184-185, pl. 41 figs. 9, a; MARTENS, 1890, Biol. Centr. Amer., Moll., p. 13; BEQUAERT, 1957, Bull. Mus. Comp. Zool., 116 (4): 225 — El Sumidero near Tuxtla-Gutierrez, Chiapas, Mexico at 1300 m. elevation.

Choanopoma chiapasense CROSSE & FISCHER, 1877, J. de Conch., 25: 362-363 — Chiapas, Mexico (F. SUMICHRAST!); FISCHER & CROSSE, 1890, Miss. Sci. au Mexique, Moll., 2: 182-184, pl. 41 figs. 8, a.

Choanopoma trochleare var. *majus* MARTENS, 1890, Biol. Centr. Amer., Moll., : 13.

Distribution. *sumichrasti*: Known from Tuxtla-Gutierrez, Chiapas and the Isthmus of Tehuantepec (CNHM 108571 SUMICHRAST! paratype), Mexico; *chiapasense*: Known from Santo Domingo (USNM 133215), Chivela (ANSP 149273) and Lagunas USNM 219717, USNM 219718, USNM 219719), Oaxaca and "Chiapas", Mexico.

Diagnostic characters. *sumichrasti*: Large (14.2-16.7 mm.), moderately slender (h/d ratio 2.10-2.23) shells with relatively low and moderately closely spaced axial ribs, no spiral sculpture and the body whorl appressed to the penultimate; whorls remaining $4\frac{3}{8}$ to $4\frac{7}{8}$; *chiapasense*: Large (14.2-19.7 mm.), moderately slender (h/d ratio 2.00-2.45) shells with low, rounded, very

crowded axial ribs, no spiral sculpture and the body whorl appressed to the penultimate; whorls remaining $4\frac{1}{4}$ to $5\frac{1}{4}$; undecorated specimens with 7 whorls were 17.8-18.3 mm. high, h/d ratio 2.38-2.44.

Remarks. The paratype of *sumichrasti* (CNHM 108571) has strong spiral color bands while the Tuxtla-Gutierrez specimens (MCZ 210308) have partially interrupted color band. Otherwise they are almost identical. Typical *sumichrasti* has spiral color patterning and less crowded, slightly more lamellate radial sculpture. Variety *chiapasense* is uniform dull brown in color with very crowded sculpture. The latter has only been definitely reported from Oaxacan localities on the Isthmus of Tehuantepec between 600 and 900 feet elevation. The differences between *sumichrasti* and *chiapasense* are exactly the same type as those found in the varieties of *Choanopoma largillierti*, *Choanopoma radiosum*, *Chondropoma cordovanum* and *Chondropoma rubicundum* discussed below.

***Choanopoma (Choanopomops) gaigei* BEQUAERT & CLENCH.**

Pl. 10 Fig. 5; Pl. 12 Fig. 24e.

Choinopoma gaigei BEQUAERT & CLENCH, 1931, Occ. Pap. Boston Soc. Nat. Hist., 5: 425-426 — Chichén Itzá, Yucatán; BEQUAERT & CLENCH, 1933, Carnegie Inst. Washington, Pub. 431: 540-542, fig. 26, pl. 68 figs. 8-11; ? GOODRICH & VAN DER SCHALIE, 1937, Univ. Mich. Mus. Zool., Misc. Pub., 34: 32 — "two localities of the northern area," Peten, Guatemala; HARRY, 1950, Occ. Pap. Univ. Michigan Mus. Zool., 524: 26-28.

Distribution. Chichén Itzá, Yucatán and surrounding area is the only confirmed locality. The nebulous Peten records of Goodrich and VAN DER SCHALIE need confirmation and may be based on a misidentification.

Diagnostic characters. Shell generally undecollated, moderately large (12.5-16.1 mm.), slender (decollated h/d ratio 2.05-2.36; undecollated h/d ratio 2.00-2.29) with relatively closely spaced lamellar axial ribs that are individually tufted at the suture and never coalesce to form "blobs" as in *C. largillierti*, spiral sculpture noticeably weaker than radial on the upper spire, becoming subequal on lower whorls, body whorl closely appressed to the spire. Whorls remaining $4\frac{1}{2}$ to $5\frac{1}{4}$, undecollated shells with 6 to $6\frac{1}{2}$ whorls.

Remarks. No specimens at all intermediate between *C. gaigei* and *C. largillierti* were seen, although both species were present in almost every sample from Chichén Itzá. The axial ribbing of *gaigei* is quite similar in form and spacing to that of *sumichrasti*, but the two shells are immediately separable by the spiral ribbing of the former. HARRY (1950) pointed out that the apical callus is placed one whorl higher in *gaigei* than it is in *largillierti* and correlated this with the lesser decollation of the former. Field studies at Chichén Itzá are needed to determine the ecological differences between *gaigei* and *largillierti*.

***Choanopoma (Choanopomops) martensianum* (PILSBRY).**

Pl. 10 Fig. 6; Pl. 12 Fig. 24f.

Chondropoma martensianum PILSBRY, 1900, Nautilus, 13: 140 — mountains of Poana, Tabasco, Mexico (José M. Roviroso!); PILSBRY, 1904, Proc. Acad. Nat. Sci. Philad.,

1903: 780, pl. 52 figs. 4, a; THOMPSON, 1957, *Nautilus*, 70 (3): 100 — Teapa, Tabasco, Mexico.

Distribution. Known from localities in southwestern Tabasco, Mexico.

Diagnostic characters. Small (9.1-13.9 mm.), slender (h/d ratio 2.00-2.48), tapering shells with widely spaced, thin axial lamellae that are much more prominent than the low spiral cords and the body whorl appressed to the penultimate. Whorls remaining $4\frac{1}{8}$ to $5\frac{1}{2}$.

Remarks. *C. cozumelensis* has the same sculpture as *C. martensianum*. The latter differs in being elongate, having the lamellar ribs simple, and chondroid opercular plate flat with the calcareous plates elevated and their edges distinctly separate. *C. martensianum* has the axial ribs somewhat serrated as in the *sargi* form of *C. radiosum*.

The Teapa specimens were collected under limestone chips and in cracks of a limestone outcrop on a talus slope.

***Choanopoma (Choanopoma) cozumelense* RICHARD.**

Pl. 10 Fig. 7; Pl. 12 Fig. 24g.

Choanopoma cozumelensis RICHARDS, 1937, *Proc. Amer. Phil. Soc.*, 77 (3): 256, pl. 4 fig. 3 — San Gerbacio, Cozumel Island, Quintana Roo, Mexico.

Distribution. Known from several localities on Cozumel Island.

Diagnostic characters Small (7.7-9.9 mm.), squat (h/d ratio 1.73-1.87) shells with high, crowded lamellar ribs that are individually tufted at the suture, spiral sculpture of low cords that are much less prominent than the axial ribs, and body whorl appressed to the penultimate. Whorls remaining 3 to $3\frac{1}{2}$. Operculum with "dished" chondroid base, the calcareous plates with overlapping edges (but not fused) and the nucleus acentral.

Remarks. The sculpture of *C. cozumelense* differs from that of *C. martensianum* only in being more crowded and in having the lamellae individually tufted at the sutures. The operculum is quite modified from the mainland type, the curving of the chondroid base having forced the edges of the calcareous plates to overlap. In *cozumelense* the plates are not fused as they appear to be in the Roatan and Utila Island *andrewsae*. This species agrees with *cozumelense* in shape and opercular characters, but sculpture relates *cozumelense* to the Mexican *martensianum* and suggests that *andrewsae* is derived from the Honduran *pleurophorum*. The reason for what seems to be parallel modifications on the off shore islands is unknown, but offers intriguing grounds for speculation and field study.

***Choanopoma (Choanopomops) pleurophorum* (PFEIFFER).**

Pl. 10 Fig. 8.

Cistula pleurophora PFEIFFER, 1852, *Monog. pneumon. viv.*: 262-263 — Honduras.

Cyclostoma pleurophorum PFEIFFER, 1853, *Proc. Zool. Soc. London*, 1851: 245; PFEIFFER, 1854, *Syst. Conch. Cab.*, I, 19 (1): 299, pl. 40 figs. 5-6.

Chondropoma pleurophorum (PFEIFFER), MARTENS, 1890, *Biol. Centr. Amer., Moll.*: 16.

Distribution. Probably known only from the type lot.

Diagnostic characters. A small (8.5 mm.), obese (h/d ratio 1.30) shell with three to six low axial riblets between the major high axial lamellae, spiral sculpture absent and body whorl strongly solute. Whorls 5. Operculum with central nucleus but only a few traces of calcareous fragments, probably indicating eroded lamellae.

Description. Shell depressed-conic, whorls 5, spire concave with whorls strongly rounded producing deep sutures. Nuclear whorls 2, minutely granulose. Remaining whorls with three to six low growth ribs (becoming lamellar in the umbilicus) between irregularly spaced high lamellar ribs. All ribs are slightly retractive. Body whorl solute for about 2.0 mm. Aperture circular, slightly rostrate above. Peristome triplex, very slightly expanded. Umbilicus open, with four widely separated, indistinct spiral cords cut by the axial ribs. Operculum with central nucleus, multispiral, showing traces of the insertion of vertical calcareous lamellae. Height 8.5 mm., major diameter 8.2 mm., minor diameter 6.3 mm.

Remarks. *Choanopoma cygni* PILSBRY was based on a single juvenile individual from Swan Island. Although similar in shape to *C. pleurophorum*, the sculpture of the nuclear whorls and spire is completely different and the two species are probably not related. The operculum of *C. pleurophorum* suggests that this is a *Choanopoma*, although the shell sculpture of *pleurophorum* is unlike any known mainland species. *C. andrewsae* from the Bay Islands off Honduras has traces of the same minor sculpture, but differs from *pleurophorum* in nearly every other character.

The only specimen of *C. pleurophorum* seen (UMMZ 79565 from the WALKER-PONSONBY collection) probably is from the type lot.

***Choanopoma (Choanopomops) andrewsae andrewsae* (ANCEY).**

Pl. 10 Fig. 9; Pl. 12 Fig. 24h.

Cyclostoma andrewsae ANCEY, 1886, Ann. Malac., 2: 251-252 — Gulf of Honduras.

Colobostylus andrewsae (ANCEY), CROSSE & FISCHER, 1888, J. de Conch., 36: 233; SIMPSON, 1897, Nautilus, 11: 13 — Utila Island, Honduras.

Chondropoma andrewsae (ANCEY), MARTENS, 1890, Biol. Centr. Amer., Moll.: 16, pl. 1 fig. 4.

Distribution. Known only from Utila Island, Honduras.

Diagnostic characters. Small (7.6-11.0 mm.), squat (h/d ratio 1.87-2.12) shells with low lamellar or weakly rounded riblets that are never tufted at the sutures, spiral sculpture absent and the body whorl appressed to the penultimate. Operculum with lamellar plates flattened with fused edges and acentral nucleus. Whorls remaining $3\frac{1}{4}$ to $3\frac{3}{4}$.

Remarks. *C. andrewsae* has the shape and operculum of *C. cozumelense*, differing from the latter in sculpture and in having the deeper "dishing" of the opercular base result in "fusion" of the overlapping edges. The shell sculpture of *andrewsae* is axial only (except for spiral cords in the umbilicus) and is equivalent to that of *pleurophorum* if the major ribs of the latter are reduced in prominence. The following subspecies differs only in being more slender than the nominate race.

***Choanopoma (Choanopomops) andrewsae roatanense* RICHARDS.**

Pl. 10 Fig. 10; Pl. 12 Fig. 24i.

Choanopoma andrewsae roatanensis RICHARDS, 1938, Proc. Amer. Phil. Soc., 79 (2): 174, pl. 3 figs. 1, 7 — West end, Roatan Island, Honduras.

Distribution. Known only from the type collection.

Diagnostic characters Same as the nominate form except for the more slender shape (h/d ratio 1.70-1.75).

Remarks. Although the original description stated that the sculpture of *roatanense* was finer than that of *andrewsae*, fine and heavily sculptured shells are found in lots from islands. The subspecies differ only in obesity. One uncorticated adult (ANSP 166965) was 11.3 mm. high with 5 whorls.

***Choanopoma (Choanopomops) largillierti* (PFEIFFER).**

Pl. 10 Fig. 11, 12; Pl. 12 Fig. 24j, k.

Cyclostoma largillierti PFEIFFER, 1846, Z. Malak., 3: 46 — Yucatán, Mexico; PFEIFFER, 1846, Syst. Conch. Cab., I, 19 (1): 121, pl. 14 figs. 26-27.

Cyclostoma grateloupi PFEIFFER, 1853, Proc. Zool. Soc. London, 1851: 246-247 — Yucatán, Mexico; PFEIFFER, 1853, Syst. Conch. Cab., I, 19 (1): 306, pl. 40 figs. 28-31.

Chondropoma grateloupi (PFEIFFER), PFEIFFER, 1863, Conch. Icon., *Chondropoma*, pl. 11 fig. 84.

Chondropoma largillierti (PFEIFFER), PFEIFFER, 1863, Conch. Icon., *Chondropoma*, pl. 11 fig. 86; MARTENS, 1890, Biol. Centr. Amer., Moll.: 19.

Cistula largillierti (PFEIFFER), FISCHER & CROSSE, 1890, Miss. Sci. au Mexique, Moll., 2: 196-197, pl. 42 figs. 10, a-b.

Cistula grateloupi (PFEIFFER), STREBEL, 1873, Beitr. Mexik. L- und Süßwasser Conch., 1: 10-11, pl. 1 fig. 4; FISCHER & CROSSE, 1890, Miss. Sci. au Mexique, Moll., 2: 198-199 pl. 42 figs. 8, a-b.

Chondropoma (Cistula) largillierti (PFEIFFER), PILSBRY, 1891, Proc. Acad. Nat. Sci., Philad., 1891: 331 — many localities in Yucatán.

Licina (Choanopomops) largillierti (PFEIFFER), H. B. BAKER, 1928, Occ. Pap. Univ. Michigan Mus. Zool., 193: 46-49.

Licina (Choanopomops) grateloupi (PFEIFFER), H. B. BAKER, 1928, Occ. Pap. Univ. Michigan Mus. Zool., 193: 49.

Choanopoma largillierti (PFEIFFER), BEQUAERT & CLENCH, 1933, Carnegie Inst. Washington, Pub. 431: 540; BEQUAERT & CLENCH, 1936, loc. cit., Pub. 457: 71-72; HARRY, 1950, Occ. Pap. Univ. Michigan Mus. Zool., 524: 26.

Choanopoma (Choanopomops) largillierti (PFEIFFER), HAAS & SOLEM, 1960, Nautilus, 73 (4): 130 — Chetumal, British Honduras.

Distribution. Numerous localities in Yucatán; Campeche, Campeche (USNM 251714, USNM 467443); and Chetumal, British Honduras (CNHM 30007).

Diagnostic characters Moderately large (10.4-16.1 mm.), moderately slender (h/d ratio 1.93-2.36) shells (when decorticated) with heavy axial ribs that swell and coalesce with one to three others to become "blobs" near the suture (Figure 24j), strong spiral sculpture and body whorl slightly solute but with peristome appressed to the penultimate whorl. Whorls remaining $3\frac{1}{2}$ to $4\frac{1}{4}$. Uncollated shells 16.5-17.3 mm. high, h/d ratio 2.47-2.50 with $7\frac{1}{4}$ to $7\frac{3}{8}$ whorls.

Remarks. FISCHER & CROSSE and H. B. BAKER (1928) have considered that *largillierti* and *grateloupi* were specifically distinct. All other workers of recent times have considered them to be variants of one species. The main difference between the two forms lies in the degree of crowding and prominence of the radial sculpture, particularly on the lower spire and body whorl. In the unsexed, often dead collected museum specimens, there is no question but that the two forms intergrade. H. B. BAKER, however, based his conclusions on the study of live collected material that he sexed and then measured. Twenty-eight specimens from near Progreso, Yucatan divided into two size classes, a smaller form with more widely spaced axial sculpture (*largillierti*) and a larger form with more crowded ribs (*grateloupi*). His measurements of height are summarized below. Other measurements are not directly comparable to those used in this study.

	<i>grateloupi</i>		<i>largillierti</i>	
	males	females	males	females
No. of adults	8	12	5	3
Height				
Mean	12.1	13.1	9.7	11.3
Range	11.1—13.0	12.2—14.1	9.3—10.7	9.9—11.8

It will be noted that within each form the size range of male and female overlaps extensively, although the males and females of one form are apparently distinct in size from the same sex of the other form. Females of the smaller form, however, considerably overlap the size range of the males of the larger. It is thus quite possible that the apparent complete intergradation observed in museum sets is an artifact introduced by mixed sets with the females of the small form confused with males of the larger.

An alternative possibility is strongly suggested by the presence of a dimorphic sculptural condition in at least four other species — *Choanopoma sumichrasti*, *Choanopoma radiosum*, *Chondropoma cordovanum* and *Chondropoma rubicundum*. In the *Chondropoma*, this dimorphism appears to be possibly ecophenotypical, since pure populations and mixed opulations of the alternate forms are known. The situation appears to be similar in *C. radiosum*, but in *C. sumichrasti* we have too little material to make any judgments. Since land prosobranchs are known to vary considerably with local moisture conditions (see SOLEM 1960: 429) it is reasonable to assume that they also vary in accordance with annual variations in moisture supply. Thus, it is not impossible that H. B. BAKER's material represents two year classes, the larger reaching adulthood in a favorable year, the smaller in a less favorable period.

Unfortunately, we have no information on longevity, periods of activity, time of breeding, growth rate or any other life history data for the American pomatiasids. The European *Pomatias elegans* (MÜLLER) is known to live four to five years (FRÖMMING 1954: 373), but it is, of course, impossible to thus assume that American pomatiasids may have a similar life span.

Without study of new collections of live collected and sexed materials we cannot hope to reach any definite conclusion as to the status of *grateloupi* and *largillierti*. Because of the sculptural dimorphism observed in other species, I

have chosen to consider them to be variations of one species, but this is purely a personal opinion.

***Choanopoma (Choanopomops) radiosum* (MORELET).**

Pl. 11 Fig. 13, 14; Pl. 12 Fig. 24l, m.

Cyclostoma radiosum MORELET, 1849, Test. noviss. Amer. Cent., 1: 22, no. 55 — Peten, Guatemala; PFEIFFER, 1854, Syst. Conch. Cab., I, 19 (1): 275, pl. 37 figs. 15, 16.

Chondropoma radiosum (MORELET), PFEIFFER, 1863, Conch. Icon., *Chondropoma*, pl. 9 fig. 69; MARTENS, 1890, Biol. Centr. Amer., Moll.: 18.

Cistula sargi CROSSE & FISCHER, 1883, J. de Conch., 31: 103 — San Miguel de Tucuru, Alta Vera Paz, Guatemala; FISCHER & CROSSE, 1890, Miss. Sci. au Mexique, Moll., 2: 191-194, pl. 42 figs. 4, a-i.

Cistula radiosa (MORELET), FISCHER & CROSSE, 1890, Miss. Sci. au Mexique, Moll., 2: 188-191, pl. 42 figs. 1, a-b.

Chondropoma sargi (FISCHER & CROSSE), MARTENS, 1890, Biol. Centr. Amer., Moll.: 18.

Cistula radiosum (MORELET), HINKLEY, 1920, Nautilus, 34 (2): 44 — Mts. of Río Cavech, Livingston, Guatemala.

Choanopoma radiosum (MORELET), GOODRICH & VAN DER SCHALIE, 1937, Misc. Pub. Univ. Michigan Mus. Zool., 34: 31 — "five localities of the central area and one of the northern," Peten, Guatemala.

Diplopoma radiosum (MORELET), GOODRICH & VAN DER SCHALIE, 1937, Misc. Pub. Univ. Michigan Mus. Zool., 34: 12, 15 — error for *Choanopoma radiosum*.

? *Choanopoma gaigei* GOODRICH & VAN DER SCHALIE, 1937 (not BEQUAERT & CLENCH, 1933), Misc. Pub. Univ. Michigan Mus. Zool., 34: 32 — A possible misidentification.

Licina radiosa (MORELET), BASCH, 1959, Occ. Pap. Univ. Michigan Mus. Zool., 612: — Tikal, Peten, Guatemala.

*Choanopoma (Colobostylus)*¹⁾ *radiosum* (MORELET), HAAS & SOLEM, 1960, Nautilus, 73 (4): 130, pl. 13 figs. 5-7 — Río Frio Cave East, Augustine, Cayo District, British Honduras.

Distribution. Peten (Uaxactun, Tikal, region of Laguna de Peten), Alta Vera Paz (San Miguel Tucuru) and Izabal (Río Cavech near Livingston), Guatemala; and British Honduras (Punta Gorda, Gales Point, Bienque Viejo, Augustine).

Diagnostic characters Relatively large (10.4-17.8 mm.), moderately slender (h/d ratio 1.88-2.35) shells with closely spaced axial ribs that are not tufted at the suture, low corded spiral sculpture and peristome strongly expanded with the body whorl appressed to the penultimate. Whorls remaining $3\frac{3}{8}$ to $4\frac{3}{4}$. Typical *radiosum* has the axial ribs very crowded with their width approximating their interstices and the axial ribs with minute bladed serrations or worn to rounded knobs. Form *sargi* has the axial ribs less crowded with the interstices to or three times their width and the blade-like serrations are very prominent.

Remarks. The lack of bunched tufted ribs, the relatively delicate sculpture and the great expansion of the peristome at once separate *C. radiosum* from the species discussed above. The relationship to *C. gruneri* and *C. küsteri* from Honduras cannot be determined until these two have been rediscovered.

Specimens referable to typical *radiosum* were seen from Tikal (MCZ 219469) and Uaxactun (USNM 382753), Peten; and near Augustine (CNHM 81247),

¹⁾ Subgeneric name added by H. B. BAKER while he was editing the manuscript. This change was not seen by the authors before publication.

Punta Gorda (USNM 251122), and Bienque Viejo Road about one mile from Cayo (USNM 382735), British Honduras. The *sargi* variation was seen from Ramate (USNM 382764) and Holha (USNM 359339), Peten; mountains of Cavech River near Livingston, Izabal (CNHM 58009, CNHM 74025, UIMZ Z-6024, UIMZ Z-5895, UIMZ Z-23590); and Punta Gorda (USNM 251121), Bienque Viejo (USNM 194129) and west of Gales Point (USNM 382783), British Honduras. The lots were not uniform and every set contained one or more individual referable to the other form. It seems certain that *radiosum* and *sargi* are extreme sculptural variations of one species. Specimens clearly referable to both varieties were seen from Punta Gorda and the Bienque Viejo region, British Honduras.

GOODRICH & VAN DER SCHALIE (1937) obviously made no attempt to distinguish *radiosum* and *sargi*, although the material they report as *Choanopoma gaigei* should be re-examined to determine whether or not it is actually the *sargi* variation. Unfortunately, they did not list the "five localities of the central area and one of the northern" that *radiosum* was reported from, so that their paper is useless in compiling distributional information.

Some long dead specimens from Gales Point, British Honduras (USNM 382715) were the largest seen, ranging from 18.3-22.2 mm. in height. Two elongated freaks were figured by HAAS & SOLEM (loc. cit.).

***Choanopoma (Choanopomops) gruneri* (PFEIFFER).**

Cyclostoma gruneri PFEIFFER, 1846, Z. Malak., 3: 47 — Honduras; PFEIFFER, 1848, Syst. Conch. Cab., I, 19 (1): 79, pl. 10 figs. 28-29.

Chondropoma gruneri (PFEIFFER), PFEIFFER, 1863, Conch. Icon., *Chondropoma*, pl. 9 fig. 68; MARTENS, 1890, Biol. Centr. Amer., Moll.: 18.

Distribution. Known only from the locality "Honduras."

Remarks. The published figures suggest a cross-hatch axial and spiral sculpture even more delicate than that of *C. radiosum*.

***Choanopoma (Choanopomops) küsteri* (PFEIFFER).**

Cyclostoma küsteri PFEIFFER, 1853, Proc. Zool. Soc. London, 1851: 249 — Honduras; PFEIFFER, 1854, Syst. Conch. Cab., I, 19 (1): 312, pl. 41 figs. 9-10.

Chondropoma küsteri (PFEIFFER), PFEIFFER, 1863, Conch. Icon., *Chondropoma*, pl. 11 fig. 87; MARTENS, 1890, Biol. Centr. Amer., Moll.: 18.

? *Cistula küsteri* (PFEIFFER), FISCHER & CROSSE, 1890, Miss. Sci. au Mexique, Moll., 2: 194-196, pl. 42 figs. 7, a-b — San Miguel Tucuru and Poctun, Alta Vera Paz, Guatemala.

Distribution. Probably only the type locality "Honduras" is correct.

Remarks. The Guatemalan records of FISCHER & CROSSE (loc. cit.) may refer to variants of the *radiosum-sargi* complex, but they could not be re-examined during this study. The poor figures of the types only serve to suggest that *küsteri* may be related to *radiosum*. It must be emphasized that the status of the above two species is uncertain since no significant collections of Hon-

duran mollusks exist in museum collections. We thus have no basis for either confirming them as valid Honduran species or rejecting them as mislabeled specimens.

Genus ***Chondropoma*** PFEIFFER, 1847

Type species *Cyclostoma sagra* ORBIGNY, 1842.

Remarks. The name *Chondropoma* is a catchall for species with a simple chondroid operculum, often with a surface layer of calcareous granules, and varying combinations of axial and spiral ribbing. The opercular nucleus is generally acentral. In West Indian species the lip may be simple and unexpanded, simple but broadly expanded, biplex or multiplex. The following ten names — *Chondropomatus*, *Chondropomium*, *Chondropometes*, *Chondropomartes* and *Chondropomorus* HENDERSON & BARTSCH, 1920; *Chondropomella* BARTSCH, 1932; *Chondropomodes*, *Gutierrezium* and *Chondropomisca* TORRE & BARTSCH, 1938; and *Wetmorepoma* BARTSCH, 1946 — have been proposed as subgenera for different sculptural types. *Chondropometes* was elevated to generic rank (TORRE & BARTSCH, 1938) but the other names are available. They have no geographic unity and probably no phylogenetic basis.

Chondropoma cordovanum, *C. callipeplum* and *C. rubicundum* have the sculpture of *Chondropomium*; *C. turritum* has the sculpture of *Chondropomorus*. I do not believe that the difference between having 1) spiral sculpture confined to the umbilicus and 2) spiral sculpture present over the entire shell with the axial ribs tufted at the suture, means anything more than minor genetic variation. It certainly is not of subgeneric importance and BARTSCH's names are not adopted below.

The several mainland species are fairly distinctive, their relationship being discussed under the individual species. At present it is absolutely impossible to try and relate them to West Indian species.

Chondropoma cordovanum PFEIFFER.

Chondropoma cordovanum PFEIFFER, 1856, Novit. Conch., 1: 91-92, pl. 25 figs. 18-19 — Cordoba, Vera Cruz, Mexico; PFEIFFER, 1863, Conch. Icon., *Chondropoma*, pl. 4 fig. 24; FISCHER & CROSSE, Miss. Sci. au Mexique, Moll., 2: 207-210, pl. 41 figs. 6, a-b; MARTENS, 1890, Biol. Centr. Amer., Moll.: 17.

Cyclostoma (Chondropoma) cordovanum PFEIFFER, 1857, Proc. Zool. Soc. London, 1856: 323.

Chondropoma (Chondropomium) cordovanum (PFEIFFER), H. B. BAKER, 1928, Occ. Pap. Univ. Michigan Mus. Zool., 193: 50 — Atoyac to Sumidero, Vera Cruz, Mexico at 1,300-3,400 feet elev.

Distribution. Recorded from Cordoba, Omealco, Potrero Nuevo (near Cordoba), Acultzingo and Motzorongo, Vera Cruz, Mexico.

Diagnostic characters. Relatively small (9.2-13.9 mm.), slender (h/d ratio 1.95-2.38) shells with crowded or widely spaced low lamellar to rounded axial ribs, spiral sculpture present only in the umbilical area, lip broadly expanded and simple or multiplex. Whorls $5\frac{3}{4}$ to $6\frac{7}{8}$ with very few decolated individuals. Color pattern quite variable. Differs from *rubicundum* by

its widely expanded lip, generally finer sculpture and more strongly rounded whorls.

Remarks. The original figure shows a shell with rather closely spaced low axial ribs and a color pattern of several spiral rows of dots (Figure 15). Many of the specimens collected by H. B. BAKER near Cordoba have the sculpture even more closely spaced and the patterning reduced to fewer dots on a darker background (Figure 16). Others in the same sets had the ribs almost as widely spaced as in a set from Potrero Nuevo (USNM 517859). These latter shells (Figure 17) correspond closely to the *acerbulum* variation of *C. rubicundum*. Fully intergrading examples were seen within single sets and there is no question but that the variations are individual and without racial value. Sexual variation is summarized by H. B. BAKER (loc. cit.).

Typically, *cordovanum* and *rubicundum* are easily separable by the much more expanded lip and more rounded whorls of the form. Subadult specimens could easily be confused and there is a wide geographic gap between known localities for the two species. FISCHER & CROSSE (loc. cit.) pointed out their close relationship and even reported a variety of *cordovanum* from Guatemala. It is not impossible that collecting in intermediate areas will locate populations that are intermediate in character between *cordovanum* and *rubicundum*. Without re-examination of the FISCHER & CROSSE material or new collections, it is much better to maintain them as distinct species with non-overlapping ranges.

***Chondropoma rubicundum* (MORELET).**

Pl. 11 Fig. 18, 19, 20; Pl. 12 Fig. 24p, q.

Cyclostoma rubicundum MORELET, 1849, Testac. noviss. Amer. Centr., 1: 22, no. 56 — Peten and Vera Paz, Guatemala; PFEIFFER, 1854, Syst. Conch. Cab., I, 19 (1): 280, pl. 37 figs. 29-30.

Cyclostoma acerbulum (MORELET), 1851, Testac. noviss. Amer. Centr., 2: 19, no. 127 — Vera Paz, Guatemala.

Chondropoma rubicundum (MORELET), PFEIFFER, 1863, Conch. Icon., *Chondropoma*, pl. 6 fig. 47; FISCHER & CROSSE, 1890, Miss. Sci., Mexique, Moll., 2: 205-207, pl. 41 fig. 5; MARTENS, 1890, Biol. Centr. Amer., Moll.: 17; A. A. HINKLEY, 1920, Nautilus, 34 (2): 42, 44, 52 — west of Livingston, Mts. of Rio Cavech, and Chama, Guatemala; GOODRICH & VAN DER SCHALIE 1937, Misc. Pub. Univ. Michigan Mus. Zool., 34: 31 — "five stations of the central area," Peten, Guatemala; VAN DER SCHALIE, 1940, Occ. Pap. Univ. Michigan Mus. Zool., 413: 5-6 — Samac, Pacalá and Volcán, Alta Vera Paz, Guatemala; BEQUAERT, 1957, Bull. Mus. Comp. Zool., 116 (4): 212 — Laguna Ocotal, Chiapas, Mexico.

Cistula subangulata MARTENS, 1886, S.-B. Ges. naturf. Freunde, Berlin, 1886: 162 — Telemán, Polochic Valley, Guatemala.

Chondropoma acerbulum (MORELET), FISCHER & CROSSE, 1890, Miss. Sci. au Mexique, Moll., 2: 210-211, pl. 41 figs. 4, a-d; MARTENS, 1890, Biol. Centr. Amer., Moll.: 17.

Chondropoma subangulatum (MARTENS), MARTENS, 1890, Biol. Centr. Amer., Moll.: 17, pl. 1 fig. 5.

Distribution. Laguna Ocotal, Chiapas (MCZ 210307) and mountains of Poana, Tabasco (ANSP 63341), Mexico; Cavech (MCZ 65555, MCZ 45473, UIMZ Z-6025, UIMZ Z-19481), Secanquini (USNM 611651), Livingston (MCZ 68470, UIMZ Z-5894, ANSP 107604, ANSP 110503), Trece Aguas (USNM 365375, ANSP 45650, MCZ 45497), Coban (MCZ 6792, USNM 162321), Flores (UMMZ 64764), west shore

of Lake Petenxil (UMMZ 64763), Chama (UIMZ Z-13791, UIMZ Z-19480), Teleman, Senahu, Samac, Pacalá and Volcán, Guatemala; and Succolz, Cayo District (USNM 193016), British Honduras.

Diagnostic characters All forms have the lip narrowly expanded and low lamellar axial ribs that are moderately widely spaced. For *rubicundum*: relatively large (10.7-15.4 mm.), elongated (h/d ratio 1.79-2.25) shells with moderately widely spaced low axial lamellar ribs, ground color reddish brown with bright orange-red aperture and few or no color spots (Figure 18). For *acerbulum*: relatively small (8.3-11.9 mm.), less elongated (h/d ratio 1.81-2.11) shells with widely spaced axial ribs, a prominent color pattern of spiral dots on a straw-colored background, aperture but lightly colored and peristome slightly more expanded (Figure 19). For *subangulatum*: Intermediate in size (10.5-12 mm.) and color (numerous spots on a light reddish-brown background) but distinguished from the other two forms in having the whorls of the spire distinctly angulated above the periphery (Figure 20).

Remarks. Many examples of the three forms are quite distinctive in appearance, but enough intergradations were seen to leave little doubt that these are variations of one species. Typical *rubicundum* was seen from Cavech, Secanquini and Livingston in Guatemala and the Mountains of Poana in Tabasco, Mexico. Typical *acerbulum* was seen from Trece Aguas and Chama in Guatemala. Mixed populations of *acerbulum* and *rubicundum* with intergrading examples were seen from Coban, Flores and Lake Petenxil, Guatemala. The latter two sets were part of the material reported on by GOODRICH & VAN DER SCHALIE, who apparently did not focus on the intergradation between *rubicundum* and *acerbulum*, since all specimens were simply called "*rubicundum*" without comments. The material from Succoltz, British Honduras was intermediate in form and color. The specimens from Laguna Ocotal, Chiapas had the form of *subangulatum*, but the color and sculpture of both *acerbulum* and *rubicundum* were represented. Several sets contained specimens with subangular spire whorls, but no typical specimens of *subangulatum* were seen.

The presence of pure populations as well as mixed sets of *acerbulum* and *rubicundum* suggests the possibility that the two forms are ecologically, if not subspecifically distinct. Without further information, no conclusions can be reached and I prefer to treat them as variations of one species. Form *subangulatum* seems to be an individual variation, so far as the angulation of whorls is concerned, and intermediate between typical *rubicundum* and variety *acerbulum* in regard to color and size. Since the original description of *subangulatum* (MARTENS, loc. cit.) is in an uncommon journal, it has been reproduced below:

4. *Cistula subangulata*. Testa perforata, ovato-conica, integra tenuiscula, costulis teneris confertis verticalibus sculpta, flavidorufescens, fasciis interruptis fuscis, in anfr. penultimo 5, in ultimo 6 picta; anfr. 6-1/2, priores 2 laeves, primus pallidus, depressus, secundus violaceo-nigricans, sequentes sculpti, medio subangulati, ultimo rotundatus, basi sulcis nonnullis spiralibus exaratus. Apertura subverticalis, ovata, superne vix angulata; peristoma duplex, rufescens, maculatum, externum leviter expansum, superne anfractui penultimo adnatum. Long 12, diam. 7-1/2; apert. long. 5, diam. 4 mm. Teleman, Guatemala; O. STOLL.

Field studies are needed to determine what, if any, are the environmental differences between the habitats of the *rubicundum* and *acerbulum* populations.

***Chondropoma callipeplum* n. sp.**

Pl. 11 Fig. 21; Pl. 12 Fig. 24r.

Chondropoma callipeplum BARTSCH, FLUCK, 1906, Nautilus, 20 (1): 4 — near Wani, Nicaragua. Nude name.

Diagnostic characters. Medium-sized (10.7-14.7 mm.), slender (h/d ratio 2.30-2.36) shells with moderately high and widely spaced lamellar ribs. Color light with spiral reddish spots, lip slight expanded, multiplex, body whorl slightly solute with peristome free of penultimate whorl. The umbilicus of the shell is wider than in *C. rubicundum*, and the larger size and more slender shape separate it from the similarly colored and sculptured *acerbulum* variation.

Holotype. United States National Museum No. 186093 from near Wani, Nicaragua. Collected by W. H. FLUCK.

Description. Shell elongate-conic, whorls $6\frac{1}{8}$ to $6\frac{7}{8}$, moderately rounded without deeply impressed sutures. Color slight straw-brown, with irregularly spaced brownish-red dots in a spiral pattern. Apical whorls 2, smooth, brownish below, white above, with a conspicuous plug just below their terminal point. Sculpture of moderately high, widely spaced, slightly retractive radial ribs, with a slight degree of individual tufting at the sutures. Spiral sculpture absent. Body whorl barely solute with the peristome free of the penultimate whorl. Peristome narrow, only slightly reflected, multiplex. Umbilicus open with traces of two or three spiral cords. Operculum with moderately acentral nucleus, no calcareous ribs, margins slightly upturned. Holotype 14.4 mm. high, minor diameter 6.1 mm., with $6\frac{7}{8}$ whorls.

Paratypes. Specimens from the type lot are: USNM 355011, CNHM 90603, ANSP 97595 and UIMZ 25952. Other paratypes are from La Luz Mine, Suira, Nicaragua (ANSP 134657, T. W. BOUCHELLE 1924).

Remarks. The wider umbilicus, more slender shape and slightly more solute body whorl are the only features separating *C. callipeplum* from *C. rubicundum*. Possibly they are only subspecifically distinct, but until collections from intermediate areas are available, it seems best to leave them as distinct species.

***Chondropoma turritum* PFEIFFER.**

Pl. 11 Fig. 22.

Chondropoma turritum PFEIFFER, 1853, Proc. Zool. Soc. London, 1851: 248 — Honduras; PFEIFFER, 1854, Syst. Conch. Cab., I, 19 (1): 310, pl. 41 figs. 1-2; PFEIFFER, 1863, Conch. Icon., *Chondropoma*, pl. 7 fig. 52; MARTENS, 1890, Biol. Centr. Amer., Moll.: 19-20.

Distribution. Described from "Honduras" but not reported since then.

Remarks. The only examined specimen (UMMZ 77930 ex WALKER, PONSONBY collections) is figured. No accompanying labels identify it as a cotype, but probably it was part of the type set. The axial ribs are denticulated at the suture much as in *Choanopoma largillierti*. In shape and sculpture. *Chondropoma turritum* appears to be a small (15-17 mm.) quite distinctive species.

Type species *Cyclostoma simile* SOWERBY, 1843 (= *Cyclostoma megacheilos* POTIEZ & MICHAUD, 1838).

Remarks. *Tudora* is a genus of the Dutch West Indies and Northern South America. The South American species were reviewed by SOLEM (1960: 428-431) and references to the pertinent literature can be found in that study. The mainland species were all referred to the subgenus *Tudorata* H. B. BAKER, 1924, and are closely related to each other. They show varying combinations of a quite similar set of characters, but these combinations seem to possess quite extensive geographic range without showing actual intergradation. For this reason, these combinations have been considered specifically distinct.

Material from the shores of Madden Lake, Canal Zone, Panama represents a new species that is named after its collector, Mr. W. D. THOMAS. Some additional specimens (USNM 251100) collected by Dr. H. PITTIER are labeled "*Pomatias obaldia*", with the locality "Panama". No species of this name has been described and PITTIER usually furnished very precise localities. There are, however, towns called Puerto Obaldia both in Coclé Province (Pacific drainage) and Comarca de San Blas (Atlantic drainage) near the Columbian-Panamanian border. PITTIER is known to have visited the latter locality (ALEXANDER WETMORE, personal communication) and the wet Atlantic drainage is a much more probable habitat than the drier Coclé site. Quite probably these shells were collected on limestone outcrops near the town.

The specimens are 13.7-16.7 mm. high with $6\frac{3}{8}$ to 7 whorls in undecollated examples. They appear to be related to both *T. thomasi* and *T. magnifica* SOLEM, but differ from both in having very heavy umbilical sculpture and a moderately expanded lip. Without confirmation of the suggested locality, nomenclatural recognition would be unwise and these shells have been labeled *Tudora* (*Tudorata*) sp.

***Tudora* (*Tudorata*) *thomasi* n. sp.**

Pl. 11 Fig. 23; Pl. 12 Fig. 24s.

Diagnostic characters. A species of *Tudora* (*Tudorata*) related to the Columbian *T. woodringi* SOLEM and *T. magnifica* SOLEM by its color, shape and shell sculpture, but differing by its much simpler and less expanded lip, reduced umbilical ribbing and less rounded whorls. Size 13.7 to 16.7 mm., complete shells with $6\frac{3}{8}$ to $6\frac{7}{8}$ whorls. *T. magnifica* has a broadly expanded lip and five or more umbilical cords. *T. woodringi* has three or four spiral cords, a white to orange apex and widely expanded lip. The Venezuelan *T. plicatula* (PFEIFFER) has a similar aperture, but differs in sculpture, shape and coloration.

Description. Shell elongate-conic, spire increasing regularly in breadth, whorls $6\frac{3}{8}$ to $6\frac{7}{8}$ in undecollated adults ($5\frac{1}{2}$ remaining in holotype), moderately rounded with impressed sutures. Apical whorls $2\frac{1}{2}$, smooth, dark purple. Decollated examples with purple plug, very gradually slanted and running almost one-half whorl. Lower whorls with sculpture of slightly retractive radial ribs that become lamellate below the suture and whose interstices are about three times their width. Body whorl appressed or slightly solute (less than

1 mm.). Umbilicus open, with only one or two strong spiral cords. Aperture with only slightly expanded lip, very similar to that of *T. plicatula*. Columella with a purple marginal band. Spire with three faint spiral bands of dots. Operculum with slightly acentral nucleus. In only specimen seen (holotype), there are remnants of vertical calcareous ridges indicating that calcareous plates have been eroded. Height of holotype 16.7 mm., minor diameter 7.5 mm., whorls remaining $5\frac{1}{2}$.

Holotype. Chicago Natural History Museum No. 73390 from the Natural Bridge of the Rio Puente near the shore of Madden Lake, Canal Zone, Panama. Collected August 8, 1958 by Mr. W. DONALD THOMAS.

Paratypes. CNHM 98193 from the type locality. Other paratypes are MCZ 111175 from the Salamanca Hydrographic Station, Río Pequeni, Canal Zone, Panama, at 300' elevation. Collected by J. A. GRISWOLD.

Remarks. The purple apex and plug, nearly vertical ribbing with lamellate prolongations near the suture, spiral dots, purple columellar band general shape and size ally *T. thomasi* and *T. magnifica*. The differences in lip, umbilical ribbing and whorl contour are considerable and provide sufficient reason for specific separation. The smallest paratype, from the Río Pequeni (a male?), was 13.7 mm. high with $6\frac{3}{8}$ whorls.

***Chondropoma vespertinum* (MORELET).**

Cyclostoma vespertinum MORELET, 1851, Testac. noviss. Amer. Centr., 2: 19, no. 128 — Palenque, Chiaps, Mexico. Erroneous Locality.

Chondropoma vespertinum (MORELET), FISCHER & CROSSE, 1890, Miss. Sci. au Mexique, Moll., 2: 211-212, pl. 41 figs. 7, 7a; MARTENS, 1890, Biol. Centr. Amer., Moll.: 19, 601.

Chondropoma (*Chondropoma*) *vespertinum* MORELET, TORRE & BARTSCH, 1938, Proc. U. S. Nat. 85: 341-342.

Distribution. Unknown.

Remarks. The types are reported to be 18-21 mm. long, sculpture of axial and spiral ribs with the former denticulated at the suture and with the lip slightly expanded. CARLOS DE LA TORRE examined the types and stated they are the same as a species from the Isle of Pines, Cuba.

Unidentified names

FISCHER & CROSSE (1890: 214-217) and MARTENS (1890: 20) discuss the unidentified names *Cyclostoma truncatum* "WIEGMANN" ROSSMÄSSLER, 1837 and *Cyclostoma* (*Tudora*) *planospira* PFEIFFER, 1856. I can add nothing to their conclusions and agree with them that they are nomia dubia. A third name, *Cistula trochlearis* PFEIFFER, 1852, needs some further discussion. FISCHER & CROSSE (loc. cit.) considered it a nomen dubium, but MARTENS (loc. cit.) applied it to *Choanopoma sumichrasti* var. *chiapasense*. The major references and probable affinities of this form are discussed below.

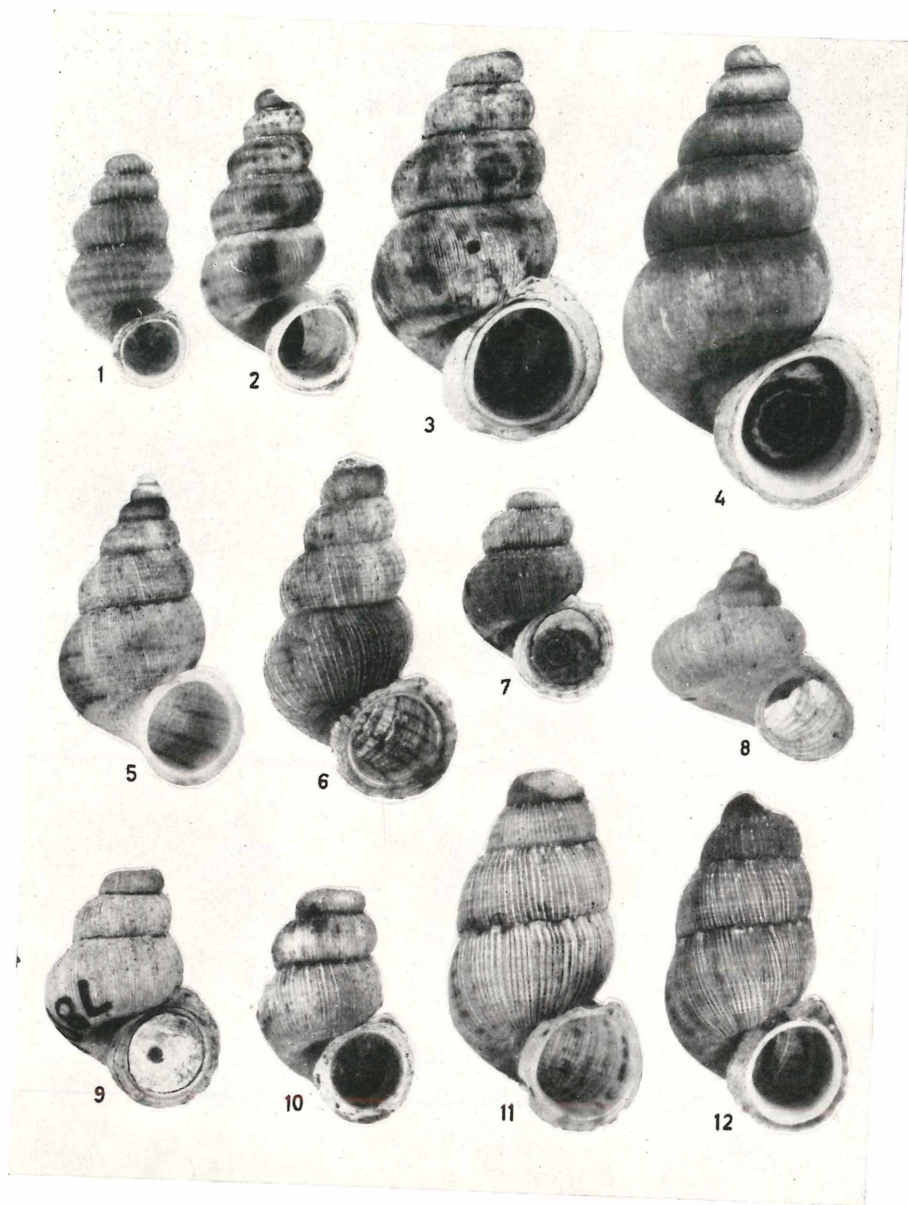
***Cistula ? trochlearis* PFEIFFER, 1852.**

- Cistula ? trochlearis* PFEIFFER, 1852, *Conspectus Cyclostomaceorum emendatus et auctus*: 68, no. 409 — no locality; PFEIFFER, 1852, *Monog. pneumon. viv.*: 275-276.
- Cyclostoma trochlea* PFEIFFER, 1853 (not BENSON, 1851), *Proc. Zool. Soc. London*, 1851: 249 — no locality.
- Cyclostoma trochleare* PFEIFFER, 1854, *Syst. Conch. Cab.*, I, 19 (1): 311-312, pl. 41 figs. 7-8 — no locality.
- ? *Chondropoma trochleare* (PFEIFFER), PFEIFFER, 1863, *Conch. Icon.*, *Chondropoma*, pl. 11 fig. 82 — Chiapas, Mexico.
- Choanopoma trochleare* (PFEIFFER), MARTENS, 1890, *Biol. Centr. Amer.*, *Moll.*: 13, 598.
- Cistula trochlearis* (PFEIFFER), FISCHER & CROSSE, 1890, *Miss. Sci. au Mexique*, *Moll.*, 2: 215-216.

Remarks. The original description was supposed to appear in the Proceedings of the Zoological Society of London, 1851. Delays in printing occurred and the date of publication was July 1853. Meanwhile, two of PFEIFFER's compilations on the family had been printed, both of which refer to 1) the unpublished original description and 2) to the plate and figures in the *Systematischen Conchylien Cabinet*, which may not have been printed until sometime in 1854. There is, to my knowledge, no conclusive evidence as to which of these several papers was actually published first and thus there is some question

Plate 10.

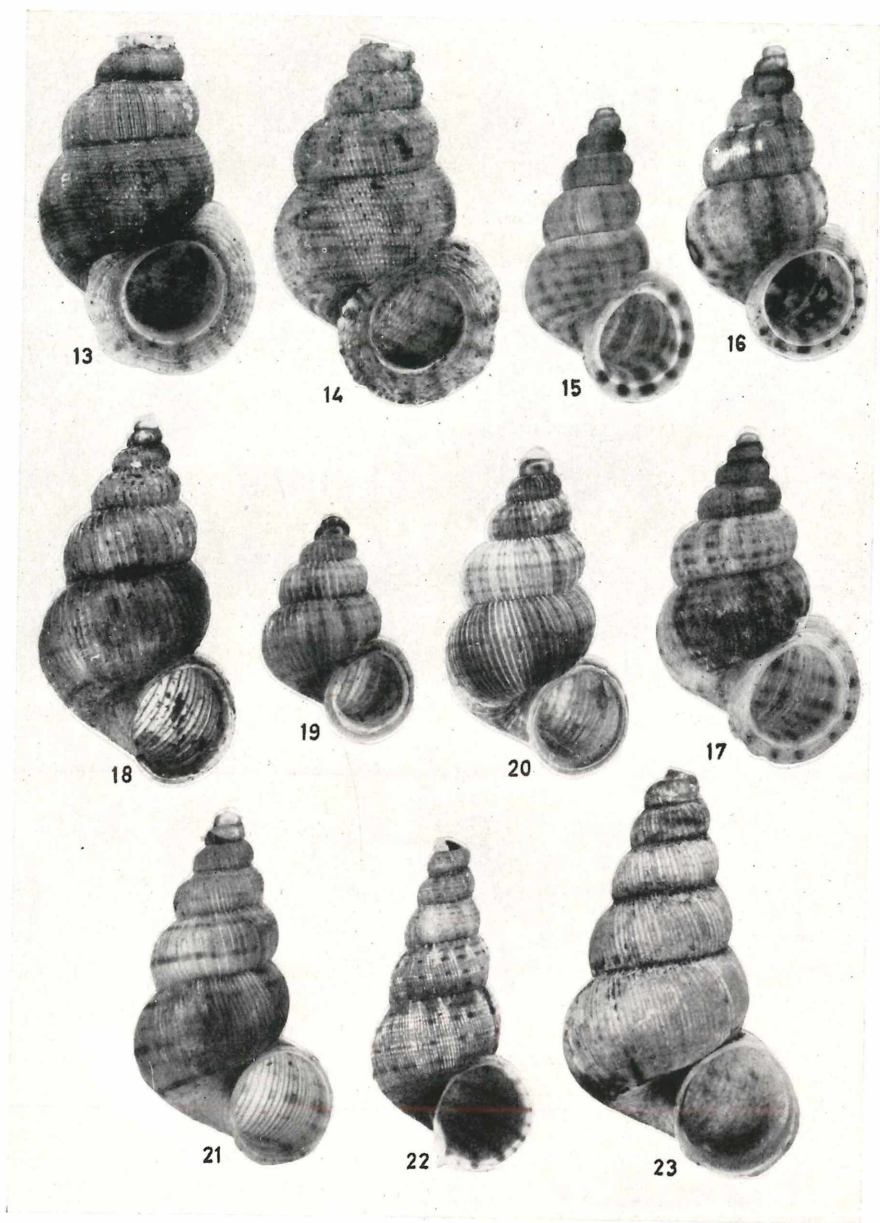
- Fig. 1. *Choanopoma (Choanopomops) rigidulum* (MORELET).
Río Frio Cave East, 2 miles west of Augustine, Cayo District, British Honduras. W. D. THOMAS! CNHM 81246.
- Fig. 2. *Choanopoma (Choanopomops) osberti* (TRISTAM).
- Fig. 3-4. *Choanopoma (Choanopomops) sumichrasti* CROSSE & FISCHER.
3) var. *sumichrasti*: El Sumidero, Tuxtla Gutierrez, Chiapas, Mexico. R. A. PAYNTER! CNHM 90607.
4) var. *chiapasense* CROSSE & FISCHER: Chiapas, Mexico. MCZ 113860 ex BEQUAERT, DAUTZENBERG.
- Fig. 5. *Choanopoma (Choanopomops) gaigei* BEQUAERT & CLENCH.
Yucatán, Mexico. USNM 355101 ex HENDERSON, SOWERBY & FULTON.
- Fig. 6. *Choanopoma (Choanopomops) martensianum* (PILSBRY).
1 mile east of Teapa, Tabasco, Mexico. F. G. THOMPSON! CNHM 84687.
- Fig. 7. *Choanopoma (Choanopomops) cozumelense* RICHARDS.
Cozumel Island, Quintana Roo, Mexico. C. J. GOODNIGHT! CNHM 72257.
- Fig. 8. *Choanopoma (Choanopomops) pleurophorum* (PFEIFFER).
Honduras. UMMZ 79565 ex WALKER, PONSONBY. Possibly a cotype.
- Fig. 9-10. *Choanopoma (Choanopomops) andrewsae* (ANCEY).
9) *andrewsae andrewsae*: Utila Id., Bay Islands, Honduras. JAMES BOND! CNHM 78844.
10) *andrewsae roatanense* RICHARDS: Roatan Island, Honduras. H. G. RICHARDS! CNHM 90606 Paratype.
- Fig. 11-12. *Choanopoma (Choanopomops) largillierti* (PFEIFFER).
11) *largillierti*: Izamal, North Yucatán. G. F. GAUMER! CNHM 11571.
12) form *grateloupi* PFEIFFER: Mérida, Yucatán, Mexico. CNHM 27622.
- Fig. 1-12. enlarged to the same scale.



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Plate 11.

- Fig. 13-14. *Choanopoma (Choanopomops) radiosum* (MORELET).
 13) *radiosum*: Punta Gorda, British Honduras. J. LYMAN! USNM 251122.
 14) form *sargi* CROSSE & FISCHER: Guatemala. USNM 203631.
- Fig. 15-17. *Chondropoma cordovanum* PFEIFFER.
 15) typical form: Mexico. USNM 355100 ex HENDERSON, REDFIELD, CUMING. Possibly a cotype.
 16) darker form: Station 4, Cordoba, Vera Cruz, Mexico. H. B. BAKER! CNHM 84688.
 17) widely ribbed form: Potrero Nuevo, Cordoba, Vera Cruz, Mexico. M. E. BOURGEOIS! CNHM 90604.
- Fig. 18-20. *Chondropoma rubicundum* (MORELET).
 18) typical *rubicundum*: Mts. back of Livingston, Guatemala. A. A. HINKLEY! MCZ 68470.
 19) form *acerbulum* MORELET: Chama, Guatemala. A. A. HINKLEY! CNHM 90605.
 20) near form *subangulatum* MARTENS: Laguna Ocotal, Chiapas, Mexico. Elevation 950 m. R. A. PAYNTER! MCZ 210307
- Fig. 21. *Chondropoma callipeplum* n. sp.
 Wani, Nicaragua. W. H. FLUCK! USNM 186093 Holotype.
- Fig. 22. *Chondropoma turritum* PFEIFFER.
 Honduras. UMMZ 77930 ex WALKER, PONSONBY. Probably a cotype.
- Fig. 23. *Tudora (Tudorata) thomasi* n. sp.
 Natural Bridge, Río Puente, Madden Lake, Canal Zone, Panama. W. D. THOMAS! CNHM 73390 Holotype.
- Fig. 13-23. enlarged to the same scale.

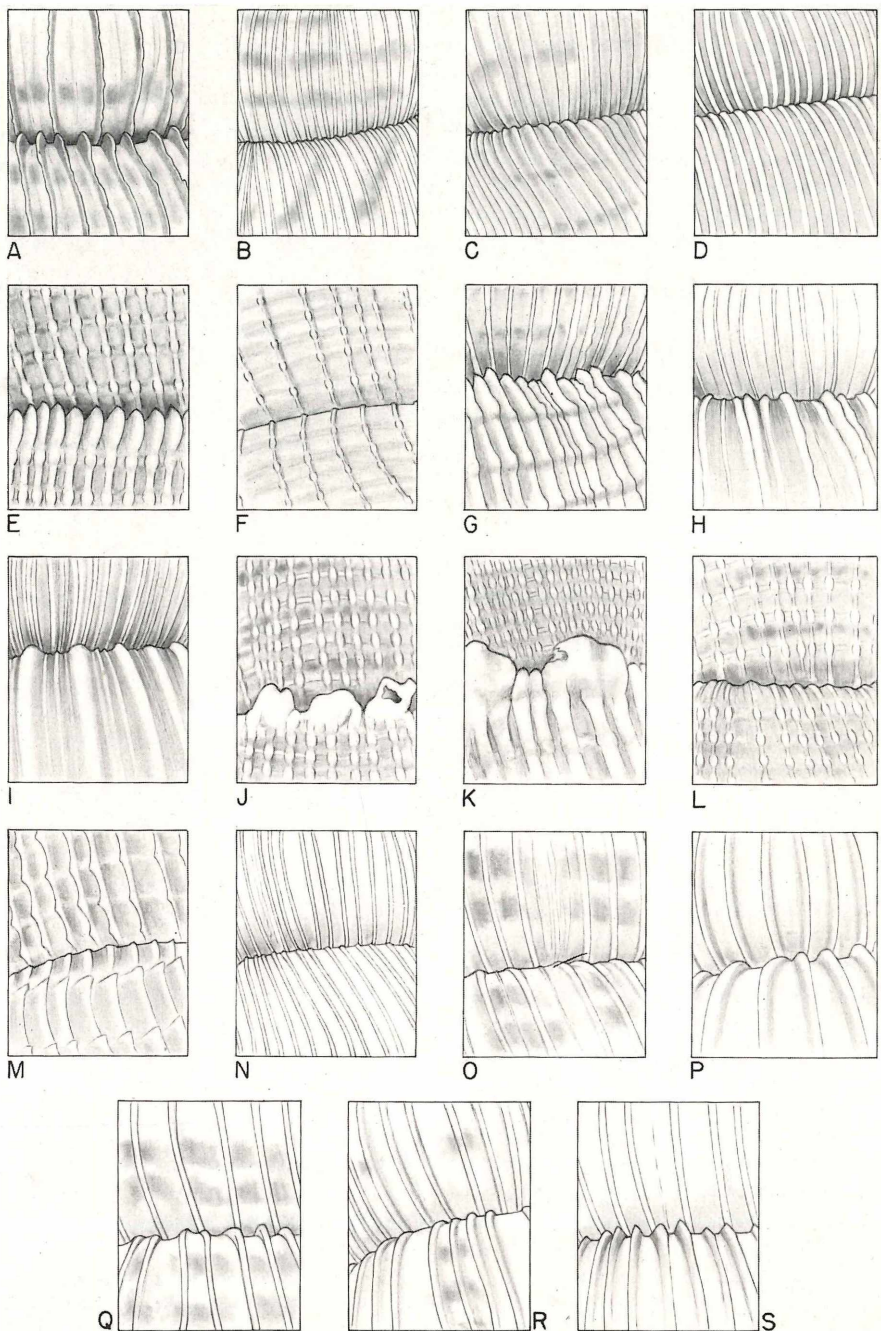


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Plate 12.

Fig. 24. Body sculpture of: a) *rigidulum*; b) *osberti*; c) *sumichrasti*; d) *sumichrasti* var. *chiapasense*; e) *gaigei*; f) *martensianum*; g) *cozumelense*; h) *andrewsi andrewsi*; i) *andrewsi roatanensis*; j) *largillierti*; k) *largillierti* var. *grateloupi*; l) *radiosum*; m) *radiosum* var. *sargi*; n) *cordovanum* (crowded sculpture); o) *cordovanum* (spaced sculpture); p) *rubicundum*; q) *rubicundum* var. *acerbulum*; r) *callipeplum*; s) *thomasi*.

Fig. 24 greatly enlarged to various scales.



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as to the correct form of the name. I have tentatively accepted *trochlearis* as correct, although it may well be that *trochleare* was actually published first. Such matters are inconsequential, since we do know what species these names represent.

Apparently two species have been confused under this set of names. The type figures resemble *Choanopoma martensianum*, but the illustration in REEVE's *Conchologica Iconica* appears to be a form very similar to *C. sumichrasti*. The only specimen (ANSP 14099) I saw that was labeled "*trochleare*" was from the CUMING collection with the locality "Mexico" It compares quite well with the types of *Choanopoma martensianum*, but there is no proof that this shell is from the type set.

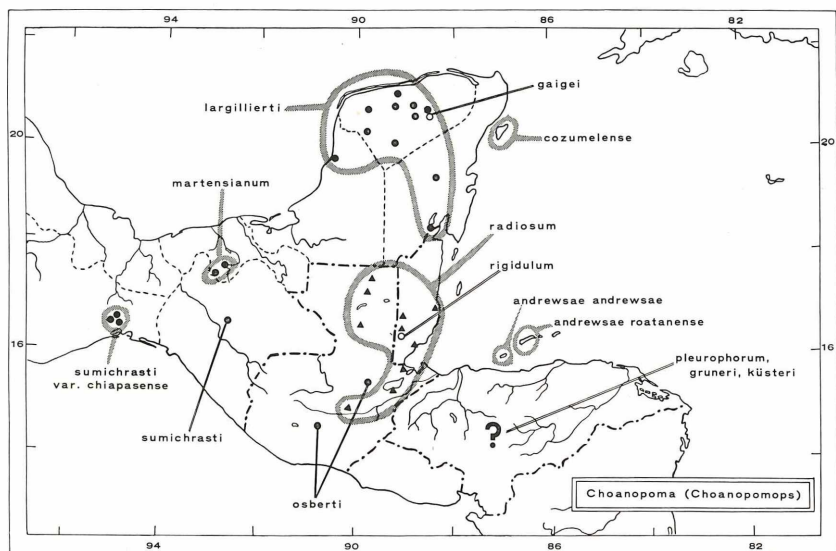
The name *trochlearis* PFEIFFER, 1852 would clear priority over *martensianum* PILSBRY, 1900. The latter, however, is well figured, has a definite type locality and has been subsequently mentioned in the literature. The former's type is unrecognized, it has a vague locality and has been mentioned in the literature since 1890 and even then was listed as an unrecognizable name. I prefer to consider it a *nomen dubium*.

Discussion

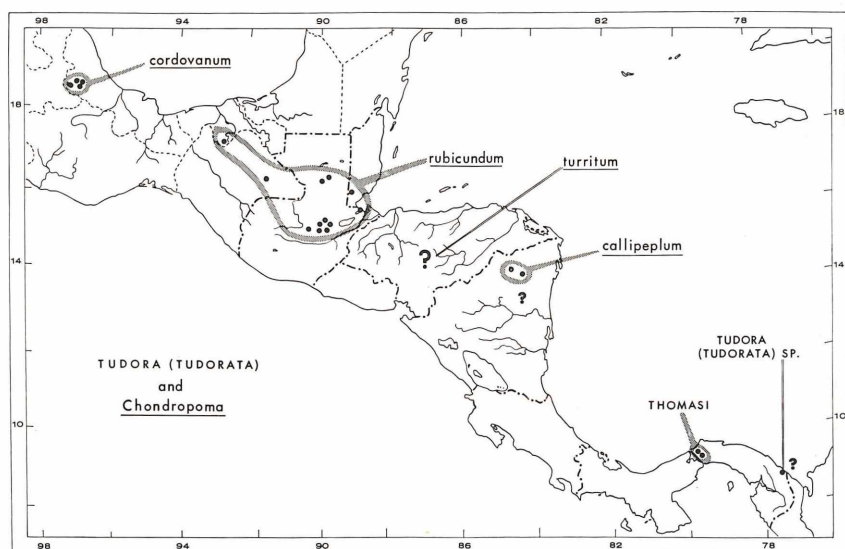
The distribution maps of *Choanopoma* (Map 1) and *Chondropoma* plus *Tudora* (Map 2) clearly indicate where collections of mollusks have been made in Central America. There can be little confidence that the recorded localities accurately reflect actual distributions. The gap between northern Nicaragua and the Canal Zone may be real, since Costa Rica has been moderately well collected without any pomatiasids being reported and northern Panama may be without the limestone areas necessary for their existence. Much of Guatemala and Southern Mexico remains to be explored for mollusks, while the snails of Honduras are known from collections made in the 1840's. A few records of mollusks from Honduras date from subsequent visits by travelers, but, essentially, no non-marine collections from that country have been made.

In view of the above limitations, no comments on the distribution of the Central American pomatiasids can be expected to withstand the test of further collecting. There is too little distributional information available to allow discussions of species distributions. It does seem possible that the Panamanian *Tudora* are a purely South American element while the *Choanopoma* and *Chondropoma* are either relicts or of recent West Indian origin.

The studies of H. B. BAKER (1928) on sexual variation in *Choanopoma largillierti* and *Chondropoma cordovanum* emphasize the need for collections of live individuals with the soft parts preserved for study. Male pomatiasids are easily recognizable in having a large external penis located on the head slightly behind the tentacles. There is a great need for adequate samples to determine 1) sex ratios, 2) intra-populational and inter-populational variations, 3) annual variation through sampling the same population in different years and 4) samples from previously uncollected areas to help determine the true rangess of the recognized species. This information can be gained through museum studies of field collections where the live individuals have been preserved in alcohol for sexing and measurement.



Map 1.



Map 2.

More important biologically will be field observations on the daily and seasonal activity periods, breeding times and habits, feeding and habitat preferences and life history information. The mechanism of plug formation and decollation of the upper whorls also can be profitably investigated. Some of the above information can be gathered during field trips, but life history studies can best be undertaken by resident naturalists. With our present lack of knowledge concerning the biology of this family, even casual observations will yield data of interest and importance. Without such data, no further real progress can be made in the systematics of the American pomatiasids.

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